Question One:
a) Briefly describe a beam and a column, and include simple sketches.
b) Mention three types of structural systems.
c) List five types of loads.

@

- Beams.
  Beams are usually straight horizontal members used primarily to carry vertical loads. Quite often they are classified according to the way they are supported, as indicated in Fig. 1–2. In particular, when the cross section varies the beam is referred to as tapered or haunched. Beam cross sections may also be "built up" by adding plates to their top and bottom

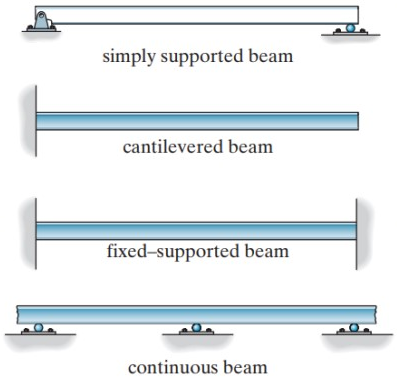


Fig. 1–2

- Columns. Members that are generally vertical and resist axial compressive loads are referred to as columns, Fig. 1–4. Tubes and wide-flange cross sections are often used for metal columns, and circular and square cross sections with reinforcing rods are used for those made of concrete.
  Occasionally, columns are subjected to both an axial load and a bending moment as shown in the figure. These members are referred to as beam columns.

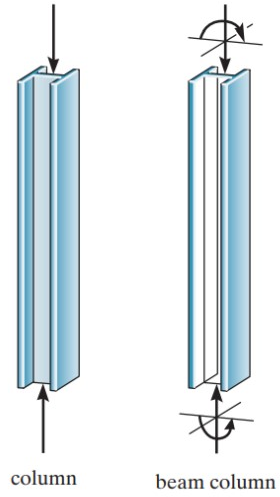


Fig. 1–4

(b)

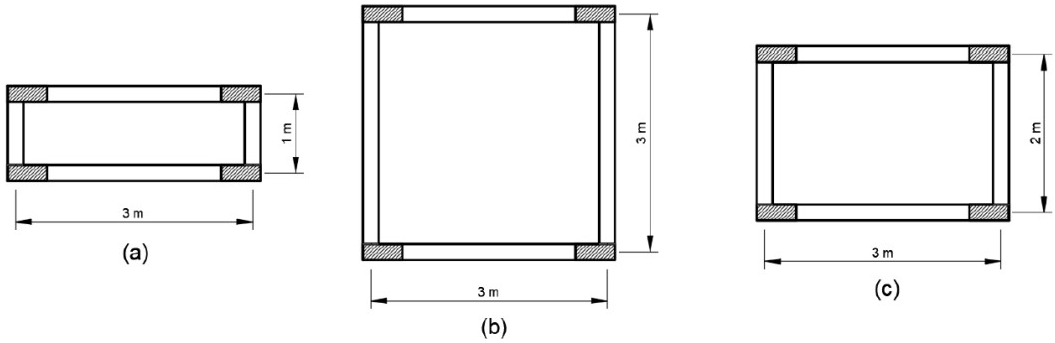
- Trusses.
- Cables and Arches.
- Frames.
- Surface Structures.

(c)

Types of Loads

- Dead Loads
- Live Loads
- Bridge Loads
- Wind Loads
- Earthquake Loads
- Hydrostatic and Soil Pressure
- Other Natural Loads

Question Two: Using the rules for one-way and two-way slabs, draw the tributary loadings on the plan view for the following slabs.



One way slab:If the ratio of length(l_y) to width(l_x) of the slab is greater than two is called as one way slab.

$\frac{l_y}{l_x} > 2$ (One way slab)

Two way slab:If the ratio of length(l_y) to width(l_x) of the slab is less than two is called as two way slab.

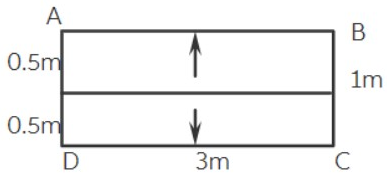
$\frac{l_y}{l_x} < 2$ (Two way slab)

a)

$l_y = 3m$

$l_x = 1m$

$\frac{l_y}{l_x} = \frac{3}{1} = 3 > 2$ (One way slab)

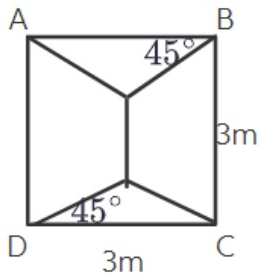


Load is transfered to beams AB and DC.

b)

$l_x = l_y = 3m$

$\frac{l_y}{l_x} = \frac{3}{3} = 1 < 2$ (Two way slab)



Triangle loading is transfered to beams AB, DC.

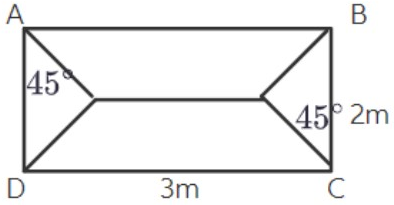
Trapezium loading is transferred to beams BC, AD.

c)

$l_x = 2m$

$l_y = 3m$

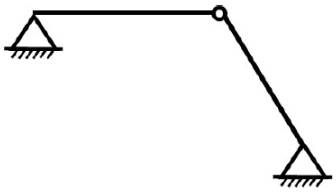
$\frac{l_y}{l_x} = \frac{3}{2} = 1.5 < 2$ (Two way slab)

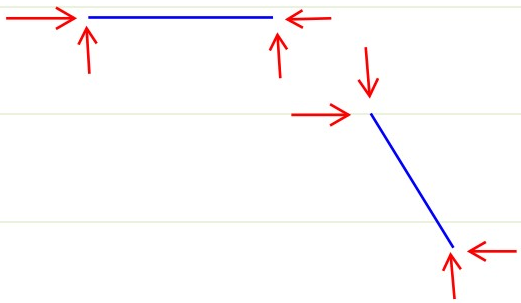


Triangle loading is transfered to beams AD, BC.

Question Three: Classify each of the following structures (from a to f) as statically determinate, statically indeterminate, or unstable. If indeterminate, specify the degree of indeterminacy.

a)

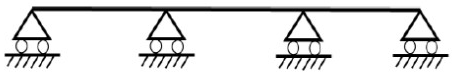




r = 3n

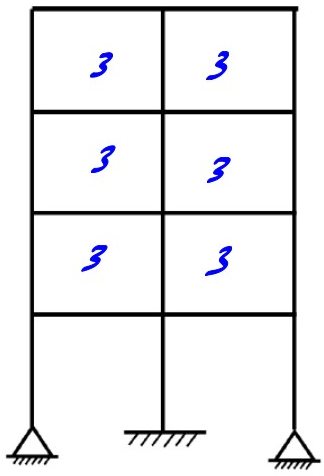
6 = 3 * 2

b)



Unstable ⇒ all reactions are parallel

c)



Unknowns = 18 + 7

equations = 3

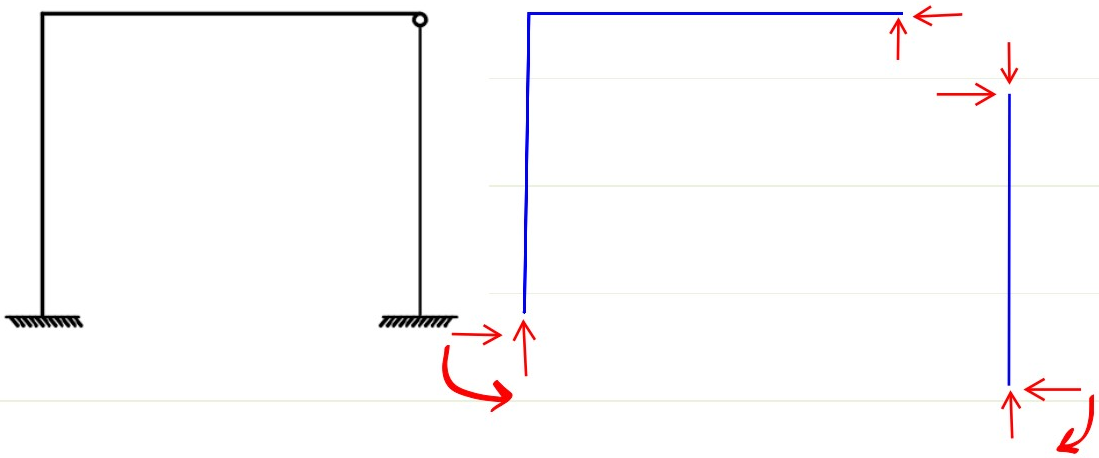
22 times indeterminate

r 3n

31 3 * 3

22 times indeterminate

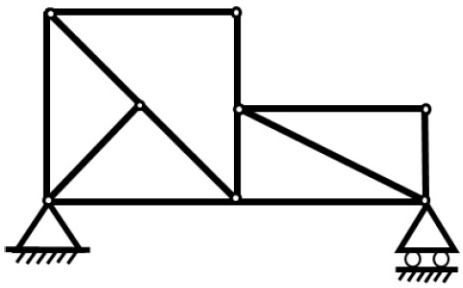
d)



r 3n

8 3 * 2 indeterminate to 2nd degree

e)



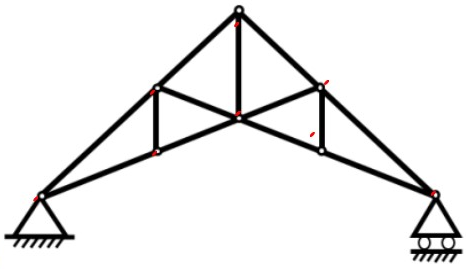
m+r 2J

12 + 3 2*8

15 16

un stable

f)



m+r 2J

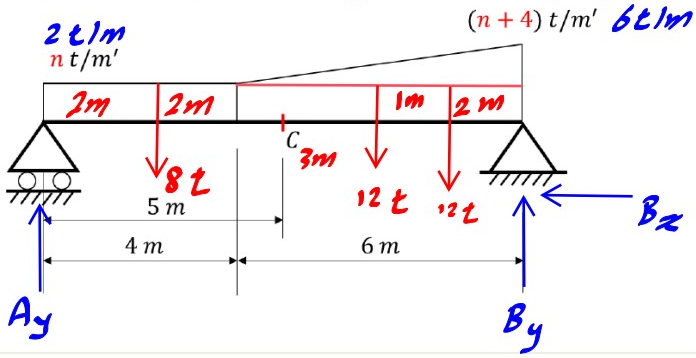
13 + 3 2*8

16 16

statically determinate

$n = 2$

Question Four: Calculate the reactions for the following beam and determine the internal normal force, shear force, and bending moment acting at point C.

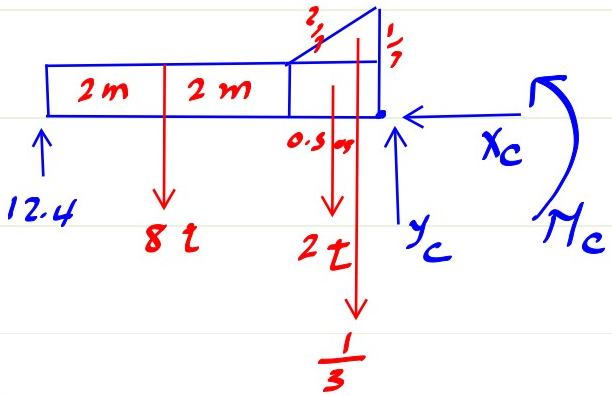


$\Sigma f_x = B_x = 0$

$\Sigma M_A = 8 * 2 + 12 * 7 + 12 * 8 - B_y * 10 = 0$

$B_y = 19.6\,KN \uparrow$

$\Sigma f_y = A_y - 8 - 12 - 12 + 19.6 = 0 \Rightarrow A_y = 12.4\,KN \uparrow$



$\Sigma f_x = X_c = 0$

$\Sigma f_y = 12.4 - 8 - 2 - \frac{1}{3} + y_c = 0 \Rightarrow y_c = -1.9\,t \uparrow = 1.9\,t \downarrow$

$\Sigma M_c = -M_c - \frac{1}{3} * \frac{1}{3} - 2 * 0.5 - 8 * 2.5 + 12.4 * 4.5 = 0$

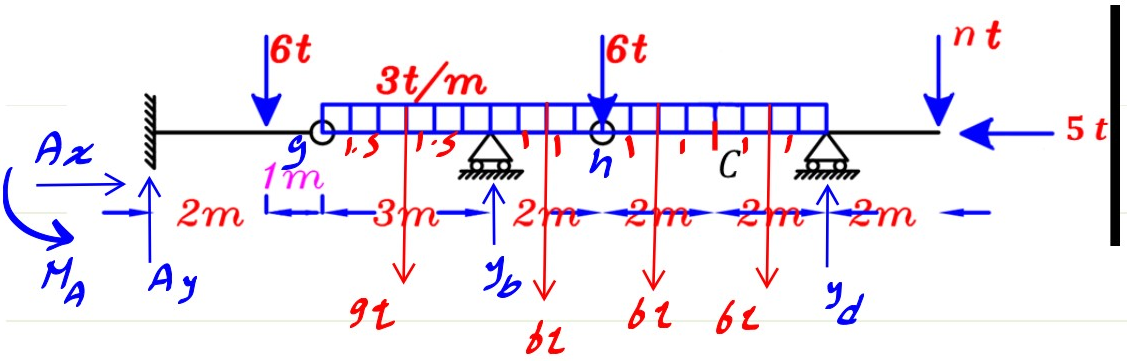
$M_c = 34.96\,KN.m$

Question Five: For the following beam: (Note: 'n' represents your serial number.)

a) Calculate the reactions.

b) Determine the internal forces acting at point C.

$Q_{T\,1} = 5$



Reactions

$\Sigma f_x = A_x - 5 = 0 \Rightarrow A_x = 5\,t \leftarrow$

$\Sigma M_{h\,right} = 6 \times 1 + 6 \times 3 - y_d \times 4 + 5 \times 6 = 0 \Rightarrow y_d = 13.5\,t \uparrow$

c

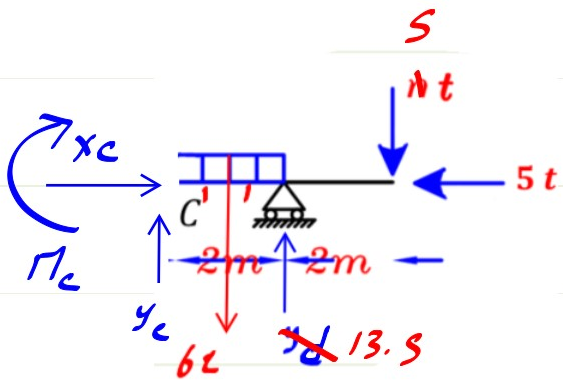
$\Sigma M_{g\,right} = 9 * 1.5 - y_b \times 3 + 6 \times 4 + 6 \times 5 + 6 \times 6 + 6 \times 8$

$- 13.5 \times 9 + 5 \times 11 = 0 \Rightarrow y_b = 28.33\,t \uparrow$

$\Sigma f_y = A_y - 6 - 9 + 28.33 - 6 - 6 - 6 - 6 + 13.5 - 5 = 0$

$A_y = 2.17\,t \uparrow$

at joint C



$\Sigma X = X_c - 5 = 0$

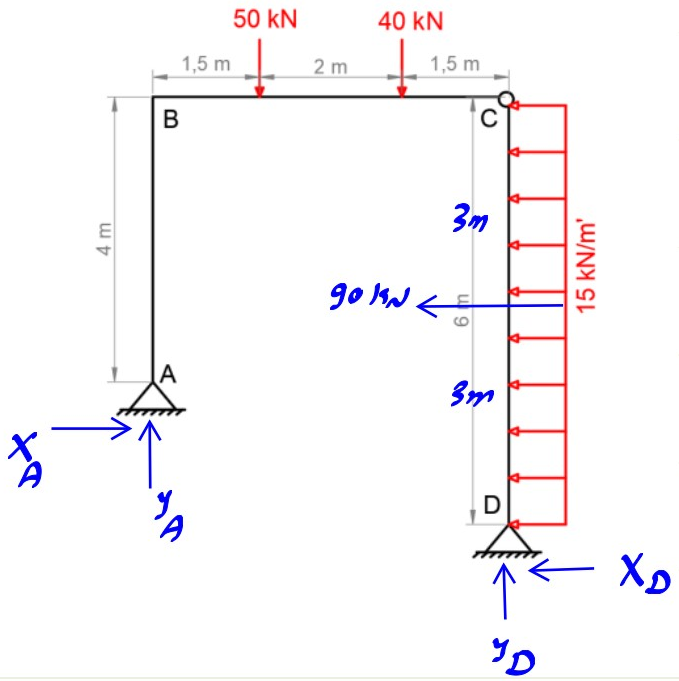
$X_c = 5t \rightarrow$

$\Sigma f_y = y_c - 6 + 13.5 - S = 0 \Rightarrow y_c = -2.5t \uparrow = 2.5t \downarrow$

$\Sigma M_c = +M_c + 6 * 1 - 13.5 * 2 + 5 * 4 = 0$

$M_c = 1 m.t$

Question Six: Determine the reactions for the following frame.



$\Sigma M_C = 90 * 3 + X_D * 6 = 0 \Rightarrow x_D = -45kN \leftarrow$

$x_d = 45kN \rightarrow$

$\Sigma f_x = x_A - 90 + 45 = 0 \Rightarrow x_A = 45kN \rightarrow$

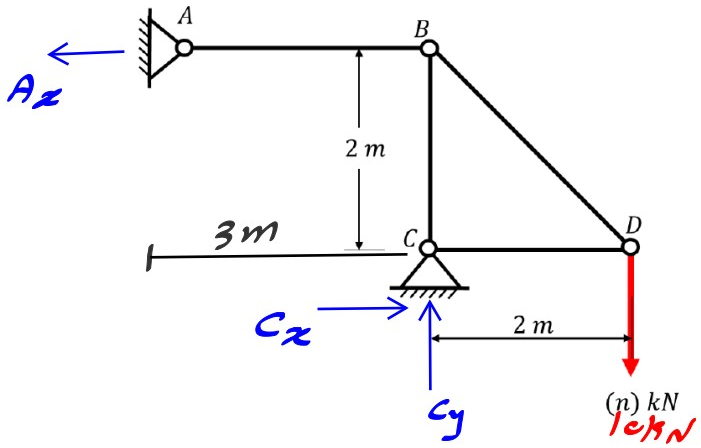
$\Sigma M_A = 50 * 1.5 + 40 * 3.5 - 90 * 1 - 45 * 2$

$- y_D * 5 = 0 \Rightarrow y_D = 7kN \uparrow$

$\Sigma f_y = y_A - 50 - 40 + 7 = 0 \Rightarrow y_A = 83kN \uparrow$

$n = 10 kN$

Question Seven: Determine the force in each member of the truss and state whether each member is in tension or compression. (Note: 'n' represents your serial number.)



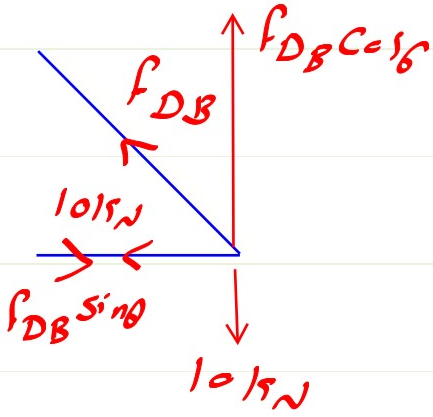
$\Sigma f_y = C_y - 10 = 0 \Rightarrow C_y = 10 kN$

$\Sigma M_A = -C_x * 2 - 10 * 3 + 10 * 5 = 0$

$C_x = 10 t \rightarrow$

$\Sigma f_x = -A_x + 10 = 0 \Rightarrow A_x = 10 kN \leftarrow$

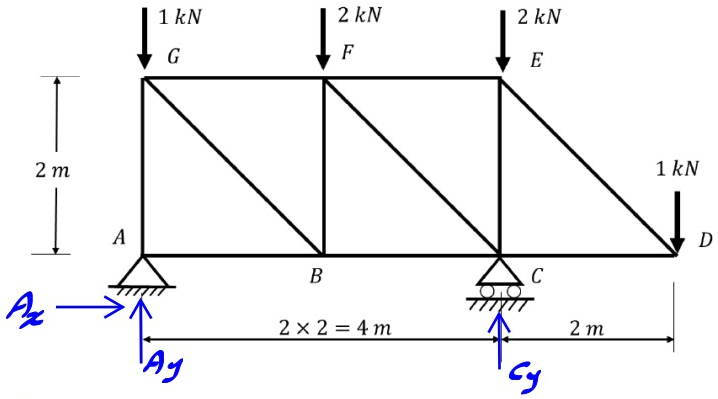
$f_{AB} = 10 kN$ Comp $\quad f_{CB} = 10\sqrt{2} kN$ Comp $\quad f_{CD} = 10\sqrt{2} kN$ Comp



$\Sigma f_x = f_{DB} * \frac{1}{\sqrt{2}} - 10 = 0$

$f_{DB} = 10\sqrt{2} = 14.14 kN$ Tension

Question Eight: Find the forces in members EF, CF, and BC of the following truss using section method.

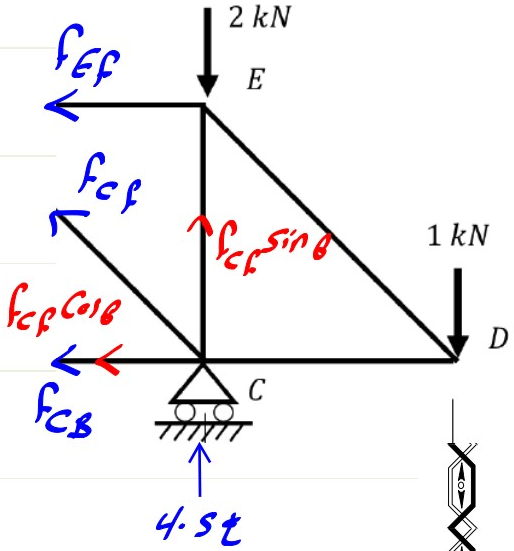


reactions

$\Sigma f_x = A_x = 0$

$\Sigma M_A = 2*2 + 2*4 + 1*6 - C_y*4 = 0 \Rightarrow C_y = 4.5\ t \uparrow$

$\Sigma f_y = A_y - 1 - 2 - 2 - 1 + 4.5 = 0 \Rightarrow A_y = 1.5\ t \uparrow$



$\Sigma M_C = -f_{EF}*2 + 1*2 = 0$

$f_{EF} = 1\ kN$ Tension

$\Sigma f_y = 4.5 - 1 - 2 + f_{CF} * \frac{1}{\sqrt{2}} = 0$

$f_{CF} = -1.5\sqrt{2} = -2.12\ kN$ Tension

$= 2.12\ kN$ Comp.

$\Sigma f_x = -f_{CB} + 1.5\sqrt{2} \cdot \frac{1}{\sqrt{2}} - 1 = 0$

$f_{CB} = 0.5\ kN$ Tension